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Characteristics of Parasitoids of Tortricidae (Lepidoptera) in Azerbaijan Republic

Sh. M. MAHARRAMOVA

A b s t r a c t : 67 species of parasitoids had been defined in result of investigation of the parasitoids playing role in regulation of the leaf rollers damaging fruit and forest plants in the Northern (Shaki-Zaqatala), the Eastern (Baku-Absheron) and the Southern (Lankaran-Astara) regions of Azerbaijan during the years of 1994-2004. 64 species of them belong to 13 families of Hymenoptera order and 3 species are the representatives of Tachinidae family of Diptera order. 15 species of the parasitoids (*Cadurcia vanderwulpi* BAR., *Cadurcia casta* ROND., *Pteromalus chrysos* WALK., *Pachyneuron formosum* WALK., *Torymus bohemani* THOMS., *Pediobius bruchicida* ROND., *Elasmus flabellatus* FONS., *Macrocentrus resinellae* L., *Macrocentrus nidulator* NEES, *Zelex albiditarsus* CURT., *Blacus diversicornis* (NEES), *Triclistus globulipes* DESV., *Triclistus* sp., *Synarsis* sp., Proctotrupidae sp.) have been recorded in Azerbaijan fauna for the first time. The parasitoid complex consists of Braconidae (32.8 %), Ichneumonidae (17.9 %) and Eulophidae (16.4 %) belonging to species of the noted family. The representatives of other families amounted to 1.49-7.46 %.

K e y w o r d s : Tortricidae; Hymenoptera; Diptera; leaf roller; host, parasitoid.

Introduction

The existence of parasitoid population in fruit-food cenoses plays specific role in keeping the number of phyllophage pests in economically imperceptible threshold. The parasitoids belonging to Hymenoptera and Diptera orders of the main part of the species content are used against pests with the purpose of bioregulation in many countries of the world.

Within the beneficial entomofauna accompanying the leaf rollers (Lepidoptera: Tortricidae) a big role is played by parasitic insects, both from the order of Hymenoptera and Diptera. They attack the larvae and pupae of tortricids, limiting the density of their population. In this way they contribute to the stability in biocenosis (KOT 2007).

The introduced paper deals with the species content of parasitoids from the order of Hymenoptera and Diptera infecting 16 species (belonging to 14 genera) of leaf rollers at the stage of caterpillar and pupae damaging fruit-forest plants in the Northern (Sheki-Zaqatala), Eastern (Baku-Absheron) and Southern (Lankaran-Astara) regions of Azerbaijan during 1994-2004 and their activity in different areas had been investigated (fig. 1). The parasitoids of only 7 species of the investigated leaf rollers have been defined, no regulation of other leaf roller species with the parasitoids have been defined.

During the research years 67 species of parasitoids that play role in natural regulation of the amount of leaf rollers by ending their development at the stage by caterpillar and pupae of leaf rollers have been defined. 64 species of them belong to Hymenoptera and 3 species belong to Diptera order. 15 of these species have been noted in the Azerbaijan fauna for the first time.

The behaviour of such parasitoids towards host-tortricids is quite uniform. 32.8 % of the amount of the parasitoids consists of the Braconidae family. The braconid female first paralyses the caterpillars found inside the feeding shelter and then deposits several eggs on the surface of the body, usually in the intersegmental folds of the abdomen. The mature parasitoid larvae leave the host's body and build – inside the caterpillar's feeding shelter – a silky, whitish to light brown cocoon (DIACONU & LOZAN 2000). Most Braconidae are oligo- and monophagous species, with no polyphagous ones or super-parasitoids (MEDVEDEV 1986). The parasitic ichneumons (Ichneumonidae) attacking leaf tortricids belong to nearly all biological categories of parasitoids: ecto- and endoparasites, mono-, oligo- and polyphagous, parasites to eggs, caterpillars, pupae; parasites of the first and second degrees as well as gregarious parasites (EVENHUIS 1980) contain 17.9 % of parasitocomplex. Being primary and secondary parasitoids of different insects Chalcididae are very valuable in exterminating pests biologically. As a rule chalcids larva parasitize inside their hosts, some of them are external parasitoid of insect larva, and sometimes even carnivores. Chalcids infect eggs, larvae, pupae and in some cases even adult insects (SWEETMAN 1958).

Ceraphronidae and Proctotrupidae - Parasitoids of insects in semi-concealed situations (Diptera, Hemiptera, Neuroptera and Thysanoptera) or hyperparasitoids of Hymenoptera prepupa. Some species trips, Lepidoptera (larva & pupa), Chrysopidae and Coniopterygidae parasitize (JOHNSON & MUSETTI 2004; JOHNSON 1992).

Parasitic insects belonging to the order Diptera: Tachinidae are primary endoparasites, most frequently oligo- and polyphagous ones (KARCZEWSKI 1978).

Material and methods

The research works had been carried out in fields and laboratory conditions during the years of 1994-2004. The laboratory works were carried out at the Institute of Zoology of Azerbaijan NAS. The field works were carried out in the months of April-September annually (table 1) and the material concerning the caterpillar and pupa stages of leaf rollers was collected and kept in laboratory condition to follow their development up to the end and to define the parasitocomplex.

The caterpillars were reared isolatedly up to the apparition of tortricid or parasitoid adults, their food being the leaves of trees from which they had been taken. The collection and use of the material has mainly carried out according to accepted methods (FASULATI 1971).

Results and Discussion

From a total number of 16 tortricid species 7 species of parasitoids belonging to

Hymenoptera and Diptera have been recorded, which behave as larval and pupal parasitoids.

During the research years (1994-2004) 1050 specimen concerning the caterpillar and pupa stages of leaf rollers had been collected. During the observation we noted the development of leaf rollers up to imago, in examples of 60.6 %, and in examples of 27.7 % we noted their being infected by parasitoids (table 2).

Analysis of species composition

Parasite complex of parasitizing leaf rollers represented by 67 species of parasitoids. 64 species of them belong to Hymenoptera and 3 species are representatives to Diptera order. From Hymenoptera order 28 species belong to Chalcidoidea, 34 species to Ichneumonidea, 1 species to Ceraphronidea and 1 species to Proctotrupidea subfamily. From Diptera order 3 species belong to Tachinidae family (table 3). 15 species of the discovered parasitoids: 5 species (*Pachyneuron formosum*, *Torymus bohemani*, *Pediobius bruchicida*, *Elasmus flabellatus*, *Pteromalus chrysos*) from Chalcidoidea superfamily, 2 species (*Triclistus globulipes*, *Triclistus* sp.) from Ichneumonidae family, 4 species (*Macrocentrus resinellae*, *Macrocentrus nidulator*, *Zelet albiditarsus*, *Blacus diversicornis*) from Braconidae family, 2 species (*Cadurcia vanderwulpi*, *Cadurcia casta*) from Tachinidae family and Ceraphronidae – *Synarsis* sp., Proctotrupidae sp. have been noted in Azerbaijan fauna for the first time.

Infection Rate with Parazitoids

Depending on the site of collection 60,6 % of leaf rollers completed their development and their death due to different reasons made 11,7 %. The rate of parasitism ranged from 0 % to 41 %: on average, parasitoids reduced the populations of leafrollers by 27,7 %. During the rearing of caterpillars and pupae of leaf tortricids numerous parasitic insects belonging to the order Hymenoptera and Diptera were obtained (table 4, figure 2).

Hymenoptera – Most of the obtained parasitoids of leaf rollers belong to the order Hymenoptera (93.7 %):

a) Braconidae constituting 32.8 % of the total parasitoids of leaf rollers dominates owing to richness of species composition. All Braconidae species are parasitoids of caterpillars only. There are no parasitoids of pupae and hyperparasitoids among them (ZEROVA 1989). According to number of species among Braconidae dominate agents of genera *Bracon* FAB., *Macrocentrus* CURT., and *Apanteles* FORST., which are represented by 4 species (table 5). The species of each 3 genera preferred *Tortrix viridana*, *Archips rosanus* and *Archips xylosteanus* species of leaf rollers as host as has been noted.

Among the representatives of genus *Macrocentrus* CURT. polyembryony is spread. Belonging to this genus *Macrocentrus collaris* constituting 14.8 % of the total population of Braconidae, were on the first place in respect of the number, on the other hand, this is a dominating species among Braconidae. This is a species attacking different leaf rollers, especially *Tortrix viridana*.

The species of genus *Bracon* FAB. own a very wide host areal. *Bracon variegator* and

Macrocentrus resinellae representing 3,2-3,3 % of Braconidae composition are in the second place. These species infect *Tortrix viridana* and *A. rosanus* species of leaf rollers.

Macrocentrus linearis, *Cotesia* sp. species occupy (2,4-2,7 %) third place among Braconidae and regulate the amount of *Tortrix viridana*, *Archips rosanus*, *Archips xylosteanus* species of leaf rollers.

b) Ichneumonidae – species are much bigger in size than Braconidae. They are caterpillar and pupa parasitoids.

Unlike Braconidae Ichneumonidae never parasitize in adult insects. Unlike Chalcidoidea and Proctotrupidea Ichneumonidae do not parasitize in the eggs of insects: in those cases when Ichneumonidae parasitize the egg, their larva stop development in the larva or pupa of the host (ATANASOV et al. 1981; ZEROVA et al. 1989).

Ichneumonidae constituting 31.4 % of the hymenopterian parasitoids of leaf rollers, stand second.

Lissonota sp. type of *Lissonota* genus constituting 25.2 % of the total population of Ichneumonidae, were on the first place in respect of the number, on the other hand, this is a dominating species among Ichneumonidae. *Lissonota* sp. is a gregar species: from one infected host caterpillar from 3 up to 5 imago of the parasitoid can complete their development. This is a species attacking different leaf rollers, especially *Tortrix viridana*, *Archips rosanus*, *Archips xylosteanus*.

Itopectis maculator species forming 1.47 % of the content of Ichneumonidae are on the second place. This species are noted as *Tortrix viridana*, *Archips rosanus* and *Archips xylosteanus* parasitoids of the investigated leaf rollers.

Itopectis maculator and *Itopectis alternans* and attack the host at the stage of pupa and they develop there forming their own cocoon (ATHANASSOV et al. 1998; MEDVEDEV 1981). On the other hand, TIAN & PIEKARSKA-BONIECKA (1998) found out that those two enumerated species of ichneumons are superparasitoids attacking Hymenoptera from the family of Braconidae or other ichneumons.

Chalcidoidea - Major parasitoids develop as a preliminary ones, however the percentage of secondary parasitoids rather high (ZEROVA et al. 1989). Chalcidoidea constituting 29.1 % of the total parasitoids of leaf rollers.

Eulophidae family constituting 16,86 % of the total population of Hymenoptera, were on the first place in respect of the number, on the other hand, this is a dominating species among subfamily Chalcidoidea. Relation of 11 species of the family was revealed. *Colpoclopeus florus* (6.76 %) belongs to Eulophidae. This is a species attacking different leaf rollers, especially *Tortrix viridana* and *Archips rosanus*. *Colpoclopeus florus* was numerous in 1995-1997. The other species of the parasitofauna *Horismenus specularis* and *Eulophus larvarum* make 3,32-3,44 % in the parasitocomplex. Both species are gregarous. They were recorded when the number of *Tortrix viridana*, *Archips rosanus* and *Pandemis cerasana* was not high.

Family Torymidae constituting 4,42 % of the total population of Hymenoptera, were on the second place in respect of the number. *Monodontomerus aereus* of this family represented by 3,2 %, gregarous species parasitizing the pupa of the pest. This is a species attacking different leaf rollers, especially *Tortrix viridana*, *Archips rosanus*, *Hedya nubiferana*.

Family Chalcididae occupies the third place among chalcids represented by 4,29 %. *Brachymeria intermedia* makes 3,93 %-of the parasitic complexes. This is a species attacking different leaf rollers, especially *Tortrix viridana*, *Archips rosanus*. Solitar species.

Ceraphronidae and Proctotrupidae constituting a few percent (about 0.4 %) of the total parasitoids of leaf rollers.

Diptera: Tachinidae – Host Tachinidae a very different and belong to several orders. Most of the Tachinidae infect the host's larva; the development can end in the larva of the latest ages, in pupae and sometimes in adult insects. Some species infect pupae (SWEETMAN 1964). Tachinidae constituting 6.3 % of the total parasitoids of leaf rollers.

Cadursia casta constituting 78.4 % of the total population of Diptera, were on the first place in respect of the number, on the other hand, this is a dominating species among Tachinidae. Individuals of this species developed of different leaf rollers, especially *Tortrix viridana*, *Archips rosanus* and *Pandemis cerasana*. *Cadursia vanderwulpi* constituting only 19.6 % of the total population of the Diptera: Tachinidae was much less numerous and were on the second place in respect of the number. And *Nemorilla maculosa* constituting only 2 % of Tachinidae, were on the third place.

There is a negative correlation between 4 species of leaf rollers (*Pandemis cerasana*, *Epinotia demarniana*, *Hedya nubiferana*, *Cydia pomonella*) and the parasitoids infecting them, namely, the parasitoids infect their hosts with high indexes in low density of leaf rollers.

On the contrary, the correlation between the species of *Archips rosanus*, *Archips xylosteanus*, *Tortrix viridana* and the parasitoids infecting them is positive which caused the parasitoids to slow down their activity at high density of these species of leaf rollers.

50 % of the collected material concerning *Cydia pomonella* species of leaf rollers have been noted to be infected by parasitoids. Development up to imago formed 25 %. *Tortrix viridana* and *Pandemis cerasana* species are on the second place due to be infected by parasitoids (41 and 40 % accordingly). And 53,5 % of *Tortrix viridana* species could complete the development up to imago.

The littlest index in getting infected by parasitoids belong to *Archips xylosteanus* (15,2 %) (table 2).

Distribution of parasitoids according to the regions of research

Distribution of parasitoids infecting leaf rollers was not equal (from 5.7 % to 83.5 %) (table 4). Thus in Lankaran region 56 species (83.5 %) of parasitoids are spread of which 54 species belong to Hymenoptera and 2 species belong to Diptera order. In Baku-Absheron region from 26 species (10.8 %) of common parasitofauna 24 species belong to Hymenoptera and 2 species are the representatives of Diptera order.

In Shaki-Zaqatala region 10 parasitoids (5.7 %) belonging to Hymenoptera are spread. No species belonging to Diptera have been found in this region.

4 species of parasitocomplex (*Brachymeria intermedia*, *Colpoclypeus florus*, *Pediobius saulius*, *Eulophus larvarum*) are the species to have been noted in the research area. 16 species of parasitoids have been noted in 2 of the research areas, and the rest 47 species have been noted only in one research area.

Distribution according to years

Observation having been done in research areas show that infection of leaf rollers by parasitoids has been different for the whole research years depending on the regions (table 4).

In Lankaran-Astara region the material had been collected in the years of 1994-1998 and 2001-2004. Cases of getting infected by parasitoids had been observed in 1994-1998 and in 2001, during the other years of research there were no cases of being infected by parasitoids. The years forming superiority according to being infected by parasitoids were 1995 and 2001 (19.4-51.4 % accordingly). The littlest cases of being infected by parasitoids was 1998 (0.2 %).

1. In Baku-Absheron region the material was collected in the years of 1995-1997, 1999-2001, 2003-2004 of which in 1995-1997 and 2000 cases of being infected by parasitoids had been observed in the other research years, no cases of being infected by parasitoids had been observed. The years forming superiority due to getting infected by parasitoids were 1996-1997 (4.4-5.9 %). The littlest cases of being infected by parasitoids was in 2000 (0.1 %).

2. In Shaki-Zaqatala region the material was collected in 1995 and the infection of leaf rollers by parasitoids formed 5.7 %.

Efficient species

In limiting the population of leaf rollers the main role belongs to species from Hymenoptera order. From species, belonging to Diptera order *Cadurcia casta* plays active role. *Monodontomerus aereus*, *Colpoclopus florus*, *Eulophum larvarum* species infecting the caterpillar stage of leaf rollers and *Cadurcia casta*, *Brachimeria intermedia* species infecting the pupa stage having been spread during several research years and in different regions, these parasitoids can be considered efficient species in regulating the caterpillar and pupa stages of leaf rollers.

Lissonota sp., *Macrocentrus collaris*, *M. resinella*, *Mesochorus* sp. species were noted only in 2001 in Lankaran region which coincides with the crisis period of mass rapid leap in the development of *Tortrix viridana* species in that area. It shows that the noted parasitoids are more active at the high density of the host population.

Distribution of the parasitoids according to the host selection

According to richness of species composition content of the infecting parasitoids of *Tortrix viridana* superiority (40 species). Among parasitoids of *Tortrix viridana* Braconidae keeps one of the main places (table 5). Ichneumonidae and Eulophidae species are on the second and third places accordingly. *Archips rosanus* is in the second place (25 species). Among the parasitoids of *Archips rosanus*, according to their number and importance braconids are on the first place (10 species). Ichneumonidae are again on the second place (5 species).

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Zusammenfassung

67 Arten Parasitoide konnten in Zusammenhang mit Forschungen um Schäden an Forst- und Obstbaumkulturen durch Wickler in Aserbajdschan (im Norden Shaki-Zaqatala, im Osten Baku-Absheron und im Süden Lankaran-Astara) im Zeitraum 1994 bis 2004 festgestellt werden. 64 Arten davon gehörten Hymenopteren aus 13 Familien an, die restlichen drei waren Dipteren der Familie Tachinidae. Folgende 15 Arten waren Neunachweise für Aserbajdschan: *Cadurcia vanderwulpi* BAR., *Cadurcia casta* ROND., *Pteromalus chrysos* WALK., *Pachyneuron formosum* WALK., *Torymus bohemani* THOMS., *Pediobius bruchicida* ROND., *Elasmus flabellatus* FONS., *Macrocentrus resinellae* L., *Macrocentrus nidulator* NEES, *Zelet albiditarsus* CURT., *Blacus diversicornis* (NEES), *Triclistus globulipes* DESV., *Triclistus* sp., *Synarsis* sp., Proctotrupidae sp. Innerhalb der Hymenopteren teilt sich der Anteil der Parasitoide auf folgende Familien auf: Braconidae (32.8 %), Ichneumonidae (17.9 %), Eulophidae (16.4 %), restliche Familien belegen 1.49-7.46 %.

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Address of the author: Sh. M. MAHARRAMOVA
Institute of Zoology, NAS of Azerbaijan Republic, 1073,
pr.1128, bl.504, Baku, Azerbaijan
E-mail: sheyda@bakililar.az

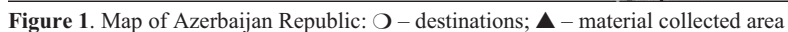


Table 1: Characteristics of the ecosystems from which leaf rollers were collected

N	Years	Locality	Characteristic
1	Shaki-Zaqatala region: 1995	Shaki city	Forest trees, fruit garden, fruit plants in the farmlands, forest plants, trees and bushes
2	Baku-Absheron region: 1995-1997 1999-2000 2004 1995-1997 2001, 2003	Baku city Absheron peninsula – Mardakan, Bilgah, Kurdakhany, Pirshaghy, Buzovna settlements	Different fruit, forest and decorative plants in the shelter belts, parks, gardens, farmlands
3	Lankaran-Astara region: 1994-1997, 2002, 2003-2004 1994-1998 1995-1996, 1998 1994, 1996 2001-2003	Lankaran distr. Astara dist. Masally distr. Hirkan National Park	Different fruit, forest and decorative plants in the shelter belts, parks, gardens, farmlands In mixed forests

Table 2: Species composition, development and mortality of leaf rollers in the studied areas

Leaf rollers	Total	Imago%	Mortality	
			Per cent of parasitoids	Dead of various causes (%)
1. <i>Pandemis cerasana</i> (HÜBNER 1786)	15	13,3	40	46,7
2. <i>Archips rosanus</i> (LINNAEUS 1758)	295	67,1	20	12,9
3. <i>Archips crataeganus</i> (HÜBNER 1799)	4	25	–	75
4. <i>Archips xylosteanus</i> (LINNAEUS 1758)	210	74,8	15,2	10
5. <i>Ptycholoma lecheana</i> (LINNAEUS 1758)	3	33,3	–	66,7
6. <i>Cacoecimorpha pronubana</i> HÜBNER 1800	5	40	–	60
7. <i>Aleimma loeflingiana</i> (LINNAEUS 1758)	6	16,7	–	83,3
8. <i>Tortrix viridana</i> LINNAEUS 1758	452	53,5	41	5,5
9. <i>Croesia forskaleana</i> (LINNAEUS 1758)	10	80	–	20
10. <i>Eudemis profundana</i> ([DENIS et SCHIFFERMÜLLER] 1775)	8	62,5	–	37,5
11. <i>Hedya nubiferana</i> HAWORTH [1811]	14	50	28,6	21,4
12. <i>Spilonota ocellana</i> ([DENIS & SHIFFERMÜLLER] 1775)	4	75	–	25
13. <i>Epinotia demarniana</i> (FISCHER VON RÖSLERSTAMM 1840)	5	20	20	60
14. <i>Gypsonoma</i> sp.	6	66,7	–	33,3
15. <i>Notocelia uddmanniana</i> (LINNAEUS 1758)	5	40	–	60
16. <i>Cydia pomonella</i> (LINNAEUS 1758)	8	25	50	25
Total	1050	60,6	27,7	11,7

Table 3. The systematic position and number of parasitoids of leaf rollers

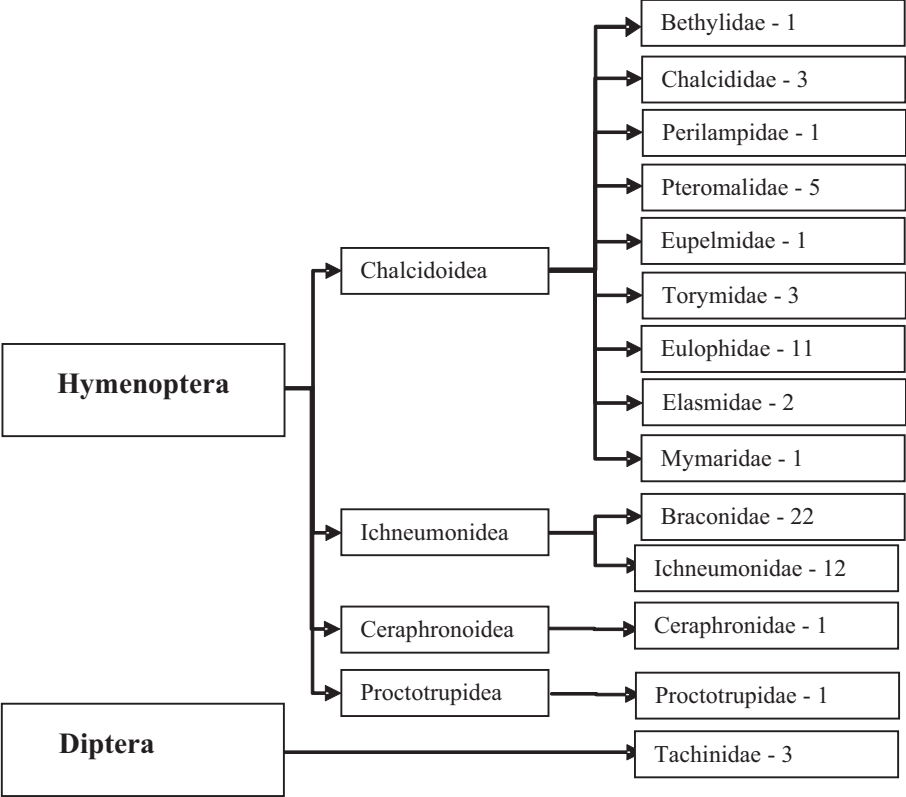


Table 4. The species composition and the number of parasitoids of leaf rollers in Azerbaijan in the years 1999-2001

[illegible]

Names of parasitoids of leaf-rollers	Lenkoran-Astara region							Baku-Absheron region				Sheki-Zakatala region			Totally	
	Number of individuals [in specimens]						Percentage contribution in given region	Number of individuals [in specimens]				Number of individuals (in specimens)		Percentage contribution in given region	Individuals (in specimens)	%
	1994	1995	1996	1997	1998	2001		total	1995	1996	1997	2000	total	Percentage contribution in given region	1995	total
6. <i>Pteromalus chrysos</i> WALK. *			1				1	1			1		1	50		2
7. <i>Pachyneuron</i> <i>formosum</i> WALK. *		1					33.3	1			2		2	66.7		3
8. <i>Pachyneuron</i> sp.											1		1	100		1
9. <i>Conomorium patulum</i> WALK.										5			5	100		5
10. Pteromalidae gen sp.		1					50	1							1	1
Eupelmidae																
11. <i>Eupelmus</i> sp.		1					100	1								1
Torymidae																
12. <i>Monodontomerus</i> <i>aereus</i> WALK.	6	9		4			73	19		5	2		7	27		26
13. <i>Monodontomerus</i> sp	1	4		2	1		88.9	8			1		1	11.1		9
14. <i>Torymus bohemani</i> THOMS. *		1					100	1								1

Names of parasitoids of leaf-rollers	Lenkoran-Astara region						Baku-Absheron region				Sheki-Zakatala region			Totally	
	Number of individuals [in specimens]						Number of individuals [in specimens]				Number of individuals (in specimens)		Percentage contribution in given region	Individuals (in specimens)	%
	1994	1995	1996	1997	1998	2001	total	1995	1996	1997	2000	total	Percentage contribution in given region	1995	total
Eulophidae															
15. <i>Colpoclypeus florus</i> WALK.		14		3			17		19			19	34.5	19	55
16. <i>Colpoclypeus</i> sp.									1			1	100		1
17. <i>Eulophus larvarum</i> L.		12		3			15		3	2		5	17.8	8	28
18. <i>Eulophinae</i> gen. sp.		1					1								1
19. <i>Microlycus</i> sp.		1					1								1
20. <i>Pediobius pyrgo</i> WALK.		6			1		7	1			1	2	22.2		9
21. <i>Pediobius saulius</i> WALK.		4					4			2		2	28.6	1	7
22. <i>Pediobius bruchicida</i> ROND. *		1					1								1
23. <i>Pediobius</i> sp.	1	3					4								4

Names of parasitoids of leaf-rollers	Lenkoran-Astara region							Baku-Absheron region				Sheki-Zakatala region			Totally									
	Number of individuals [in specimens]							Percentage contribution in given region							Number of individuals (in specimens)		Percentage contribution in given region		Individuals (in specimens)	%				
	1994	1995	1996	1997	1998	2001	total	1995	1996	1997	2000	total	1995	1996	1997	2000	total	1995	1996	1997	2000	total		
	Percentage contribution in given region							Percentage contribution in given region							Percentage contribution in given region									
24. <i>Horismenus specularis</i> ERD	27						27	100															27	3.32
25. <i>Aprostocetus</i> sp.														2									3	0.4
Elasmidae																								
26. <i>Elasmus viridiceps</i> THOMS		7	1				8	100															8	0.98
27. <i>Elasmus flabellatus</i> FONS. *			1				1	100															1	0.12
Mymaridae																								
28. <i>Polinema</i> sp.																								
Braconidae																								
29. <i>Clinocentrus exsertor</i> NEES	1						1	100															1	0.12
30. <i>Rogas bicolor</i> SPIN.		1					1	100															1	0.12
31. <i>Rogas ductor</i> THUNB.				1			1	100															1	0.12

Names of parasitoids of leaf-rollers	Lenkoran-Astara region						Baku-Absheron region				Sheki-Zakatala region			Totally		
	Number of individuals [in specimens]						Percentage contribution in given region				Number of individuals (in specimens)		Percentage contribution in given region		Individuals (in specimens)	%
1994	1995	1996	1997	1998	2001	total	1995	1996	1997	2000	total	1995	total	26	3.2	
32. <i>Bracon (H.) variegator</i> SPIN.	4	3	13	5			25	96.2	1	3.8					2	0.24
33. <i>Bracon trucidator</i> MARSH.				2			2	100							1	0.12
34. <i>Bracon longicollis</i> WESM.				1			1	100							2	0.24
35. <i>Ceratobracon stschelegolevi</i> TEL.		2					2	100							1	0.12
36. <i>Bracon</i> sp.									1	100					2	0.24
37. <i>Macrocentrus</i> (A.) <i>linearis</i> NEES	2	14		4			20	100							20	2.46
38. <i>Macrocentrus</i> (A.) <i>collaris</i> SPIN.						121	121	100							121	14.86
39. <i>Macrocentrus resinellae</i> L. *						27	27	100							27	3.3
40. <i>Macrocentrus nidulator</i> NEES*						4	4	100							4	0.5

Names of parasitoids of leaf-rollers	Lenkoran-Astara region							Baku-Absheron region				Sheki-Zakatala region			Totally	
	Number of individuals [in specimens]						Percentage contribution in given region	Number of individuals [in specimens]				Number of individuals (in specimens)		Percentage contribution in given region	Individuals (in specimens)	%
	1994	1995	1996	1997	1998	2001	total	1995	1996	1997	2000	total	1995	total		
41. <i>Microdus rufipes</i> NEES		3					3	100							3	0.4
42. <i>Ascogaster quadridentata</i> WESM.													4	4	4	0.5
43. <i>Apanteles laevigatus</i> RATZ		4		4			8	88.9		1		1			9	1.1
44. <i>Apanteles enarginatus</i> NEES									1			1			1	0.12
45. <i>Apanteles albipennis</i> NEES		1					1	50	1			1			2	0.24
46. <i>Apanteles ater</i> RATZ.		4		2			6	85.7		1		1			7	0.86
47. <i>Cotesia</i> sp.		3	1			18	22	100							22	2.7
48. <i>Meteorus versicolor</i> (WESM.)						1	1	100							1	0.12
49. <i>Zelet abiditarsus</i> CURT *	1	3					4	80	1			1			5	0.6
50. <i>Blacus diversicornis</i> (NEES)*						6	6	100							6	0.74

Names of parasitoids of leaf-rollers	Lenkoran-Astara region						Baku-Absheron region				Sheki-Zakatala region			Totally	
	Number of individuals [in specimens]						Number of individuals [in specimens]				Number of individuals (in specimens)		Percentage contribution in given region	Individuals (in specimens)	%
	1994	1995	1996	1997	1998	2001	total	Percentage contribution in given region				1995	total	Percentage contribution in given region	
Ichneumonidae															
51. <i>Itoplectis maculator</i> (FABR.)		1				11	12	100							12 1.47
52. <i>Itoplectis alternans</i> (GRAV.)		2		1			3	75						1 25	4 0.5
53. <i>Apechthis capulifera</i> (KRIECHB.)						1	1	100							1 0.12
54. <i>Apechthis rufata</i> (Gmelin in Linnaeus)		2					2	66.7						1 33.3	3 0.4
55. <i>Glypta</i> sp.		2				1	3	42.9				4	4	57.1	7 0.86
56. <i>Apophua bipunctoria</i> (Thunb.)						1	1	100							1 0.12
57. <i>Lissonota</i> sp.						205	205	100							205 25.2
58. <i>Diadegma</i> sp.						1	1	100							1 0.12
59. <i>Triclistus globulipes</i> (Desv.)*						9	9	100							9 1.1
60. <i>Triclistus</i> sp. *						2	2	100							2 0.24

Names of parasitoids of leaf-rollers	Lenkoran-Astara region							Baku-Absheron region				Sheki-Zakatala region			Totally	
	Number of individuals [in specimens]							Number of individuals [in specimens]				Number of individuals (in specimens)		Percentage contribution in given region	Individuals (in specimens)	%
	1994	1995	1996	1997	1998	2001	total	1995	1996	1997	2000	total	1995	total	Percentage contribution in given region	
61. <i>Mesochorus</i> sp.						10	10								10	1.23
62. <i>Pimplinae</i> sp.						1	1								1	0.12
Ceraphronidae																
63. <i>Synarsis</i> sp. *	2						2								2	0.24
Proctotrupidae																
64. <i>Proctotrupidae</i> sp. *								1				1		100	1	0.12
Diptera																
Tachinidae																
65. <i>Cadarcia vanderwulpi</i> BAR. *	10						10								10	1.23
66. <i>Cadarcia casta</i> ROND. *	17		8				25			15		15		37.5	40	4.9
67. <i>Nemorilla maculosa</i> MEIG.										1		1		100	1	0.12
Total	43	158	18	40	2	419	680	3	36	48	1	88	46	46	814	100

Names of parasitoids of leaf-rollers	Lenkoran-Astara region						Baku-Absheron region				Sheki-Zakatala region		Totally					
	Number of individuals [in specimens]						Number of individuals [in specimens]						Percentage contribution in given region		Percentage contribution in given region		Number of individuals (in specimens)	Percentage contribution in given region
	1994	1995	1996	1997	1998	2001	total	1995	1996	1997	2000	total	1995	total	Individuals (in specimens)	%		
Percentage contribution of all species in given site	83						11.2						5.8					

* - New to Azerbaijan fauna!

Table 5. Distribution of parasitoids reducing the number of leaf rollers in Azerbaijan (1994-2004)

Species of leaf rollers	Hymenoptera												Diptera
	Chalcidoidea								Ichneumonidea				Ceraphronoidea
	Chalcididae	Pteromalidae	Eupelmidae	Torymidae	Eulophidae	Elasmidae	Mymaridae	Bethylidae	Bracconidae	Ichneumonidae	Ceraphronidae	Tachinidae	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Tortrix viridana</i> L.	40	<i>Brachymeria intermedia</i> NEES <i>B. rugulosa</i> FORST.	<i>Pteromalus chrysos</i> WALK. <i>Pachyneuron</i> sp.	<i>Eupelmus</i> sp.	<i>Monodontomerus aerus</i> WALK. <i>Monodontomerus</i> sp.	<i>Colpoclypeus florus</i> (WALK.) <i>Eulophus larvarum</i> L. <i>Eulophinae</i> gen. sp. <i>Microlycus</i> sp. <i>Pediobius bruchicida</i> (ROND.) <i>P. saulius</i> (WALK.) <i>P. pyrgo</i> WALK. <i>Pediobius</i> sp.	<i>Elasmus viridiceps</i> THOMS.	-	<i>Contosus claripennis</i> FORST.	<i>Bracon variegator</i> SPIN. <i>Macrocentrus collaris</i> (SPIN.) <i>M. resinellae</i> L. <i>M. nidulator</i> (NEES) <i>M. linearis</i> NEES <i>Microdus rufipes</i> NEES <i>Apanteles laevigatus</i> RATZ. <i>A. albipennis</i> NEES <i>Cotesia</i> sp. <i>Meteorus versicolor</i> (WESM.) <i>Zelet albidariusus</i> CURT.	<i>Itoplectis maculator</i> F. <i>Apechitis capulifera</i> KRIECHB. <i>Pimplina</i> sp. <i>Glypta</i> sp. <i>Apophua bipunctoria</i> THUMB. <i>Lissonota</i> sp. <i>Triclistus globulipes</i> DESV. <i>Triclistus</i> sp. <i>Mesochorus</i> sp.	<i>Synarsis</i> sp.	<i>Cadarcia casta</i> (ROND.) <i>C. vanderwulpi</i> BARANOV
Total		2	2	1	2	8	1	-	1	11	9	1	2

To be continued table 5

1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Archips rosanus</i> (L.)	24	<i>Brachymeria intermedia</i> NEES	<i>Conomorium patulum</i> WALK.		<i>Monodontomerus aerus</i> WALK.	<i>Colpochypus florus</i> (WALK.) <i>Eulophus larvarum</i> L.		<i>Polynema</i> sp.	<i>Contosus claripennis</i> FORST.	<i>Clinocentrus exsertor</i> NEES <i>Bracon variegator</i> SPIN. <i>Macrocenurus nidulator</i> (NEES) <i>M. linearis</i> NEES <i>Ascogaster quadridentata</i> WESM. <i>Apanteles laevigatus</i> RATZ. <i>A. albipennis</i> NEES <i>A. ater</i> RATZ. <i>Cotesia</i> sp. <i>Blaesus diversicornis</i> (NEES)	<i>Ioplectis maculator</i> F. <i>Lissonota</i> sp. <i>Diadegma</i> sp. <i>Triclistus globulipes</i> DESV. <i>Mesochorus</i> sp.		<i>Cadurcia casta</i> (ROND.) <i>Nemorilla maculosa</i> (MEIG.)
Total		1	1		1	2		1	1	10	5		2
<i>Archips xylosteanus</i> (L.)	8									<i>Macrocentrus resinellae</i> L. <i>M. nidulator</i> (NEES) <i>Cotesia</i> sp.	<i>Ioplectis maculator</i> F. <i>Lissonota</i> sp. <i>Triclistus</i> sp. <i>Triclistus globulipes</i> DESV. <i>Mesochorus</i> sp.		
Total										3	5		
<i>Hedya nubiferana</i> (HAW.)	4				<i>Monodontomerus</i>	<i>Eulophus larvarum</i> L. <i>Aprostocetus</i> sp.			<i>Contosus claripennis</i> FORST.				
Total		–	–	–	1	2			1				

